Appendix 1

TECHNOLOGIES FOR FUNDAMENTAL RESEARCH IN PHYSICS AND ASTROPHYSICS information sheet

Department	Dipartimento di Fisica e Astronomia "Galileo Galilei" - DFA
Coordinator	Prof. Mosè Mariotti
Number of positions	30
SCHOLARSHIP funded by MD 118/2023 ***See Appendix***	**SCHOLARSHIP N.1** HOSTING UNIVERSITY/RESEARCH CENTRE: Università Roma Tre CURRICULUM: Elettrotecnica ed elettrotecnica per acceleratori TOPIC: Surface impedance of superconductors under conditions of interest for fundamental physics: measurements and methods **SCHOLARSHIP N.2** HOSTING UNIVERSITY/RESEARCH CENTRE: Gran Sasso Science Institute CURRICULUM: Rivelatori, laser e ottica TOPIC: Development of innovative detectors for next-generation rare event searches **SCHOLARSHIP N.3** HOSTING UNIVERSITY/RESEARCH CENTRE: Università degli Studi di Padova CURRICULUM: Meccanica TOPIC: Corrosion of components made by additive manufacturing for extreme applications **SCHOLARSHIP N.4** HOSTING UNIVERSITY/RESEARCH CENTRE: Università degli Studi di Napoli Federico II CURRICULUM: Meccanica TOPIC: Advanced design of experimental systems for physics and astrophysics **SCHOLARSHIP N.5** HOSTING UNIVERSITY/RESEARCH CENTRE: Università degli Studi di Genova CURRICULUM: Elettronica TOPIC: Design and characterization of a Data Acquisition Board for High Energy Physics Experiment with 1G/10G Copper/Optical Ethernet connection **SCHOLARSHIP N.6** HOSTING UNIVERSITY/RESEARCH CENTRE: Università degli Studi di Cagliari CURRICULUM: Sistemi di calcolo e informatica TOPIC: Reconstruction, calibration, and identification methods based on machine learning and AI for future experiments in fundamental physics **SCHOLARSHIP N.7** HOSTING UNIVERSITY/RESEARCH CENTRE: Università degli Studi di Padova CURRICULUM: Meccanica TOPIC: Development and optimization of metal additively manufactured components for the thermal management in the fields of nuclear fusion and fundamental research in Physics and Astrophysics **SCHOLARSHIP N.8** HOSTING UNIVERSITY/RESEARCH CENTRE: Politecnico di Bari CURRICULUM: Rivelatori, laser e ottica TOPIC: Studies of reconstruction algorithms for the next generation of MeV-GeV gamma rays satellite missions for the National HPC Center **SCHOLARSHIP N.9** HOSTING UNIVERSITY/RESEARCH CENTRE: Università degli Studi di Roma,

	Tor Vergata CURRICULUM: Sistemi di calcolo e informatica TOPIC: Advanced Machine learning Methods for Complex Big Data Analytics **SCHOLARSHIP N.10** HOSTING UNIVERSITY/RESEARCH CENTRE: Politecnico di Torino CURRICULUM: Rivelatori, laser e ottica TOPIC: Applications of integrated photonics for a new generation of astrophysical space measurements
SCHOLARSHIP funded by DM 117/2023 ***See Appendix***	**SCHOLARSHIP N.11** HOSTING UNIVERSITY/RESEARCH CENTRE: Sapienza Università di Roma CURRICULUM: Meccanica TOPIC: Mechatronics for fundamental physics experiments
SCHOLARSHIP FUNDED BY UNIVERSITY/OTHER BODIES ***See Appendix***	**SCHOLARSHIP N.12** HOSTING UNIVERSITY/RESEARCH CENTRE: INAF - Osservatorio di Astrofisica e Scienze dello Spazio - OAS di Bologna CURRICULUM: Elettronica TOPIC: Definition, development and testing of front-end electronics for high-energy astrophysics detectors **SCHOLARSHIP N.13** HOSTING UNIVERSITY/RESEARCH CENTRE: INFN – Sezione di Roma 1 CURRICULUM: Sistemi di calcolo e informatica TOPIC: Development and porting of artificial intelligence algorithms on FPGA for nanosecond inference in real-time systems of high energy physics experiments **SCHOLARSHIP N.14** HOSTING UNIVERSITY/RESEARCH CENTRE: INFN – sezione di Roma Tor Vergata CURRICULUM: Sistemi di calcolo e informatica TOPIC: Machine Learning techniques for Big Data analysis in space-borne astroparticle physics experiments **SCHOLARSHIP N.15** HOSTING UNIVERSITY/RESEARCH CENTRE: INFN - Laboratori Nazionali di Legnaro CURRICULUM: Elettrotecnica ed elettrotecnica per acceleratori TOPIC: Development of innovative robotic systems for remote inspections and interventions in experimental areas **SCHOLARSHIP N.16** HOSTING UNIVERSITY/RESEARCH CENTRE: INFN – Sezione di Bari CURRICULUM: Elettronica TOPIC: Design of read-out electronics in 28 nm CMOS technology for next generation pixel detectors **SCHOLARSHIP N.17** HOSTING UNIVERSITY/RESEARCH CENTRE: Università degli Studi di Bari Aldo Moro CURRICULUM: Rivelatori, laser e ottica TOPIC: Hadron Calorimeter MPGD-based development for future Muon Collider experiment **SCHOLARSHIP N.18** HOSTING UNIVERSITY/RESEARCH CENTRE: INAF - Osservatorio Astronomico

	di Brera CURRICULUM: Rivelatori, laser e ottica TOPIC: Innovative holographic optical elements for modern optical instrumentation **SCHOLARSHIP N.19** HOSTING UNIVERSITY/RESEARCH CENTRE: INAF Osservatorio Astrofisico di Arcetri CURRICULUM: Rivelatori, laser e ottica TOPIC: Technologies for the phasing of segmented pupil optical telescopes **SCHOLARSHIP N.20** HOSTING UNIVERSITY/RESEARCH CENTRE: Università Roma Tre CURRICULUM: Elettronica TOPIC: Image recognition development on FPGA through AI in harsh environment. **SCHOLARSHIP N.21** HOSTING UNIVERSITY/RESEARCH CENTRE: INAF-IAPS di Roma CURRICULUM: Elettronica TOPIC: Performance study of TimePIX ASICs for 3D track imaging for X-ray Polarimetry in Astrophysics **SCHOLARSHIP N.22** HOSTING UNIVERSITY/RESEARCH CENTRE: INFN – Laboratori Nazionali del Gran Sasso CURRICULUM: Meccanica TOPIC: Study, realization and optimization of cryogenic components for Kelvin (K) and milliKelvin (mK) applications **SCHOLARSHIP N.23** HOSTING UNIVERSITY/RESEARCH CENTRE: Istituto Nazionale di Astrofisica – Istituto di Radioastronomia CURRICULUM: Elettronica TOPIC: New Optical and RF Over Fiber Technologies for New Generation Radio Telescopes **SCHOLARSHIP N.24** HOSTING UNIVERSITY/RESEARCH CENTRE: INFN- Sezione di Perugia CURRICULUM: Rivelatori, laser e ottica TOPIC: Integrated sensors and read-out electronics technologies development for High Energy Physics experiments **SCHOLARSHIP N.25** HOSTING UNIVERSITY/RESEARCH CENTRE: INFN- Sezione di Cagliari CURRICULUM: Rivelatori, laser e ottica TOPIC: High spatial and temporal resolution pixelated radiation sensors for next generation experiments in fundamental physics **SCHOLARSHIP N.26** HOSTING UNIVERSITY/RESEARCH CENTRE: INFN- Sezione di Bari CURRICULUM: Sistemi di calcolo e informatica TOPIC: Addressing large-scale data processing challenges with solutions tailored for AI-oriented scientific use-cases **SCHOLARSHIP N.27** HOSTING UNIVERSITY/RESEARCH CENTRE: INAF Osservatorio Astrofisico di Catania CURRICULUM: Sistemi di calcolo e informatica TOPIC: Analysis of Astrophysical phenomena using efficient and parallelized models on HPC systems

	SCHOLARSHIP N.28 HOSTING UNIVERSITY/RESEARCH CENTRE: INFN – Sezione di Torino CURRICULUM: Sistemi di calcolo e informatica TOPIC: Advanced computing systems for Gravitational-wave research **SCHOLARSHIP N.29** HOSTING UNIVERSITY/RESEARCH CENTRE: Università degli Studi di Padova CURRICULUM: Elettronica TOPIC: CAP - CMOS Advanced Pixels		
SCHOLARSHIP FUNDED OTHER BODIES , FREE RESEARCH TOPIC ***See Appendix***	**SCHOLARSHIP N.30** HOSTING UNIVERSITY/RESEARCH CENTRE: INFN – Sezione di Napoli		
Selection criteria	PRESELECTION ON THE BASIS OF EVALUATION OF QUALIFICATIONS AND ORAL EXAMINATION		
Oral examination via remote interview:	Applicants, who have requested this on their application form, will take the oral exam via remote interview using the ZOOM videoconferencing tool.		
Evaluation criteria	Qualifications: max 45 points Oral examination: max 55 points Candidates may apply for admission to more than one topic, with a maximum of 3 topics. The project proposal will be unique for all applications submitted.		
Documents to be submitted	**Curriculum:**	Points: max 35	- Candidate Profile: 1) Relevance of your profile with respect to the Curriculum indicated and with respect to a specific research topic (“Tema Vincolato”) selected; 2) Extended summary of the master's / specialist / old system degree thesis. For candidates who have not yet obtained the master's degree (or equivalent), the summary must be countersigned by the supervisor; - Candidate career: Grade Point Average, weighted by the number of credits, for exams taken in the Laurea Triennale+ Magistrale/Specialistica or arithmetic average for exams taken in the Laurea Vecchio Ordinamento. For students with a foreign degree, provide the Grade Point Average (GPA) for each degree obtained. - Other titles: 1) Time spent abroad during your studies including virtual exchange activities (e.g. Erasmus grants, Time, Erasmus Placement, thesis abroad, etc.); 2) Relevant work experience after graduation (research grants, scholarships, internship periods, period of employment); 3) Scientific awards relevant to the curriculum; 4) Other qualifications (e.g., teaching assistantships).
	Scientific publications:	Points max 3	Scientific publications: publications in journals/conferences proceedings/books and patents; report full bibliographical information (name of authors, journal or conference name, volume, publication year, pages, DOI). Manuscripts accepted for publication will be considered only if DOI is provided. WARNING: insert publication data in the “LIST OF QUALIFICATIONS” template available at: https://www.unipd.it/en/national-phd-programme-technologies-fundamental-research-physics-

			astrophysics
	Reference Letter:	Point max 7	Candidate Reference Letters (maximum two) by University or Company referees, to be completed strictly through the PICA procedure; Reference letters (maximum two) written through the PICA web form by a faculty member or a person working in industry a motivational letter (no more than two pages) explaining the candidate's research interests, in particular how these fit in with the chosen lines of research. The motivational letter must be prepared according to the "PhD motivational letter" template available at: https://www.unipd.it/en/national-phd-programme-technologies-fundamental-research-physics-astrophysics
Preselection: First meeting of the Evaluating Commission	**September, 08th 2023, 9.30 a.m. CEST**		
Publication of the results of the evaluation of the preselection	Within **September, 15th 2023** the evaluating Commission will publish the results of the evaluation of the qualifications in the following website: https://www.unipd.it/en/national-phd-programme-technologies-fundamental-research-physics-astrophysics Candidates who have passed the pre-selection on the basis of their qualifications, with a pass-mark of at least 70/100, will be admitted to the oral examination.		
Publication of the timetable of remote interviews and instructions on how to use the ZOOM video conferencing	By **September, 15th 2023** the commission will publish on the website https://www.unipd.it/en/national-phd-programme-technologies-fundamental-research-physics-astrophysics the timetable of the remote interviews and the instructions for using the ZOOM videoconferencing for those applicants who have chosen in their application form to take the oral examination via remote interview and who have passed the preselection on the basis of the qualifications with a pass-mark of at least 7/10.		
Oral examination	19/09/2023, 02:00 p.m. CEST - The exam may continue: 20/09/2023, 9:00 a.m. CEST, 21/09/2023 ore 9:00 a.m. CEST, 22/09/2023, 9.00 a.m. CEST		

APPENDIX

SCHOLARSHIP N.	**1**
FOUNDED BY	Ex DM 118/2023 - Action Line: PNRR
TOPIC	Surface impedance of superconductors under conditions of interest for fundamental physics: measurements and methods
CURRICULUM	Elettrotecnica ed elettrotecnica per acceleratori
CONTACTS	Enrico Silva enrico.silva@uniroma3.it
HOSTING UNIVERSITY/RESEARCH CENTRE	Università Roma Tre
DEPARTMENT	Dipartimento di Ingegneria Industriale, Elettronica e Meccanica, Via Vito Volterra 62, 00146 Roma. diiem.uniroma3.it
DESCRIPTION	New experiments and infrastructures for fundamental physics (e.g, the Future Circular Collider (FCC) project at CERN, some families of haloscopes for axion detection) require superconductors with low surface impedance Z at radio- or microwave frequencies (RF), in high dc magnetic fields, and/or at high cryogenic temperatures (50 K – 60 K, FCC), i.e. in conditions very different from those extensively explored so far. The research program foresees the measurement of Z in relevant superconductors in the mixed state (magnetic fields dc B_dc~1-10 T), with the aim of (1) designing and implementing, if necessary, new measurement systems; (2) explore the nonlinear regime (RF power dependence); (3) determine the applicable physical models. The analysis of the experimental data foresees an accurate evaluation of the reliability and of the uncertainties involved in obtaining the physical parameters from theoretical models. A semester of research at CERN is foreseen.

SCHOLARSHIP N.	**2**
FOUNDED BY	Ex DM 118/2023 - Action Line: PNRR
TOPIC	Development of innovative detectors for next-generation rare event searches
CURRICULUM	Rivelatori, laser e ottica
CONTACTS	Lorenzo Pagnanini lorenzo.pagnanini@gssi.it
HOSTING UNIVERSITY/RESEARCH CENTRE	Gran Sasso Science Institute
DEPARTMENT	Area di Fisica Viale Crispi 7 L'Aquila www.gssi.it
DESCRIPTION	The fellowship will focus on the development of innovative detectors to search for rare events, such as dark matter direct interactions, neutrinoless double beta decay, supernova neutrinos. The research activities carried out at GSSI in these fields exploit the strong synergy with the Laboratori Nazionali del Gran Sasso (LNGS), and benefit from the unique low background environment that the LNGS is able to guarantee. The selected candidate will focus on a detector technology, carrying out the research project in the field of low-temperature calorimeters (COSINUS, CUPID, RESNOVA), time projection chambers (Dark Side-20k, INITIUM/CYGNO) or semiconductor diodes (LEGEND). The project may also include the development systems for detector assembly and characterization, the optimization of sensors and electronics, and the development of new analysis techniques.

SCHOLARSHIP N.	**3**
FOUNDED BY	Ex DM 118/2023 - Action Line: PNRR
TOPIC	Corrosion of components made by additive manufacturing for extreme applications
CURRICULUM	Meccanica
CONTACTS	Irene Calliari irene.calliari@unipd.it
HOSTING UNIVERSITY/RESEARCH CENTRE	Università degli Studi di Padova
DEPARTMENT	Dipartimento di Ingegneria Industriale Via Gradenigo, 6/a - 35131 Padova https://www.dii.unipd.it/

DESCRIPTION

3DP is used for energy generation and storage for the much needed green energy transition. Corrosion testing and protection of 3D printed components for nuclear fusion reactors and thermal storage are being tackled in this project. To achieve nuclear fusion conditions in ITER, the neutral beam injector is mandatory, with components exposed to high temperature gradients, electrical tensions and high vacuum. To dissipate high thermal fluxes requires efficient cooling circuits and high thermal conductivity materials. Thermal storage systems where efficient thermal properties of the liquid fluid (molten salts) are being coupled with materials that can resist thermal transient and corrosion require the same. The work aims to compare the corrosion/erosion performance of 3DP alloys with standard manufactured ones. CuCrZr alloys will tested at ITER NBTF water condition, high velocity (up to 12 m/s) and T (150 C), 3DP Ni alloys will be tested in contact with molten salts at high T (550 C).

SCHOLARSHIP N.	**4**
FOUNDED BY	Ex DM 118/2023 - Action Line: PNRR
TOPIC	Advanced design of experimental systems for physics and astrophysics
CURRICULUM	Meccanica
CONTACTS	Luca Esposito luca.esposito2@unina.it
HOSTING UNIVERSITY/RESEARCH CENTRE	Università degli Studi di Napoli Federico II
DEPARTMENT	Dipartimento di Ingegneria Chimica, dei Materiali e della Produzione Industriale Piazzale V. Tecchio 80, 80125 Napoli, ITALIA www.dicmapi.unina.it
DESCRIPTION	Successful scientific experiments in physics and astrophysics often requires design and fabrication of prototypal devices with extraordinary performance. Increasingly, cross-functional skills from mechatronics to physics are required. An ideal candidate has a mechanical background with knowledge of structural analysis supported by FEM calculations.

SCHOLARSHIP N.	**5**
FOUNDED BY	Ex DM 118/2023 - Action Line: PNRR
TOPIC	Design and characterization of a Data Acquisition Board for High Energy Physics Experiment with 1G/10G Copper/Optical Ethernet connection
CURRICULUM	Elettronica
CONTACTS	Paolo Gastaldo, Rodolzo Zunino paolo.gastaldo@unige.it
HOSTING UNIVERSITY/RESEARCH CENTRE	Universitá degli Studi di Genova
DEPARTMENT	Dipartimento di ingegneria navale, elettrica, elettronica e delle telecomunicazioni - DITEN Via Opera Pia 11a, 16145 Genova http://www.diten.unige.it
DESCRIPTION	In the framework of Jlab experimental program (https://www.difi.unige.it/en/research/experimental-physics-of-fundamental-interactions/jlab-experiment) a newly approach to the data acquisition is emerging. Up to now dedicated backend systems were used, like VME, VXS or custom data concentrator. Nowadays the emerging low cost network devices (smart switches) allow the direct data transfer from the source to the processing computer. The development of a multichannel custom ADC card used to handle analog data coming from a particle detector with a local FPGA which implements a 1G/10G Ethernet protocol and a TCP/IP hardware stack can be very useful and adopted in various scenarios. The candidate will act in first person in all the steps: • design and prototype testing • characterization in lab with small detectors • real detector setup at Jlab for particle beam testing.

SCHOLARSHIP N.	**6**
FOUNDED BY	Ex DM 118/2023 - Action Line: PNRR
TOPIC	Reconstruction, calibration, and identification methods based on machine learning and AI for future experiments in fundamental physics
CURRICULUM	Sistemi di calcolo e informatica
CONTACTS	Pierluigi Bortignon pierluigi.bortignon@unca.it
HOSTING UNIVERSITY/RESEARCH CENTRE	Università degli Studi di Cagliari
DEPARTMENT	Dipartiment di Fisica Complesso Universitario di Monserrato S.P. Monserrato-Sestu Km 0,700 - 09042 Monserrato (CA) - ITALY, https://www.unica.it/unica/it/dip_fisica.page
DESCRIPTION	Innovative machine learning architectures, like Deep Neural Networks, provide an important improvement in the reconstruction and calibration efficiency in events of fundamental physics. Deep Graph Neural Networks allow to tailor neural network architecture designs to the structure of the data improving even further the reconstruction and identification performance. The project focuses on the study, the identification, the implementation, and optimisation of machine learning models for the reconstruction, the calibration, and the identification of events coming from next generation detectors of fundamental physics, like for example interferometers for gravitational waves detection or particle detectors. The preparation and manipulation of big amount of data requires an effort of data engineering and the design of adequate interface for modern computing farm exploring tools like for example multithreading and GPU.

SCHOLARSHIP N.	**7**
FOUNDED BY	Ex DM 118/2023 - Action Line: PNRR
TOPIC	Development and optimization of metal additively manufactured components for the thermal management in the fields of nuclear fusion and fundamental research in Physics and Astrophysics
CURRICULUM	Meccanica
CONTACTS	Simone Mancin simone.mancin@unipd.it
HOSTING UNIVERSITY/RESEARCH CENTRE	Università degli Studi di Padova
DEPARTMENT	Dipartimento di Tecnica e Gestione dei Sistemi Industrial Stradella S. Nicola, 3, 36100 Vicenza VI https://www.gest.unipd.it/it
DESCRIPTION	This doctoral project aims at training a researcher to develop and optimize metal additively manufactured components for the efficient and effective thermal management of critical systems in the fields of nuclear fusion and fundamental research in Physics and Astrophysics. Through the most advanced modeling techniques and topological optimization, thermo-mechanical and surface characterizations, novel methods will be developed and validated in order to propose innovative procedures to improve the reliability and repeatability of the 3D printed metallic heat exchangers. This project aims to train an inter- and multi- disciplinary researcher who can advance the techniques for the development of 3D printed metallic components for thermo-fluid dynamics applications coupled to critical systems for nuclear fusion and fundamental research in Physics and Astrophysics.

SCHOLARSHIP N.	**8**
FOUNDED BY	Ex DM 118/2023 - Action Line: PNRR
TOPIC	Studies of reconstruction algorithms for the next generation of MeV-GeV gamma rays satellite missions for the National HPC Center
CURRICULUM	Rivelatori, laser e ottica
CONTACTS	Elisabetta Bissaldi elisabetta.bissaldi@poliba.it
HOSTING UNIVERSITY/RESEARCH CENTRE	Politecnico di Bari
DEPARTMENT	Dipartimento Interateneo di Fisica. Via Amendola 173 - 70125 Bari, https://www.uniba.it/it/ricerca/dipartimenti/fisica
DESCRIPTION	Research activities will concern the development of specific reconstruction algorithms, in the context of high-energy physics space experiments. In particular, it will focus on the analysis of the Compton interaction due to photons in the MeV energy range in small and medium -sized satellites. The successful candidate will develope algorithms, simulations and analysis techniques for the National High-Power-Computing (HPC) research Center, "Big Data" and "Quantum Computing", as part of the Italian national recovery and resilience plan.

SCHOLARSHIP N.	**9**
FOUNDED BY	Ex DM 118/2023 - Action Line: PNRR
TOPIC	Advanced Machine learning Methods for Complex Big Data Analytics
CURRICULUM	Sistemi di calcolo e informatica
CONTACTS	Maurizio Talamo maurizio.talamo@uniroma2.it
HOSTING UNIVERSITY/RESEARCH CENTRE	Università degli Studi di Roma, Tor Vergata
DEPARTMENT	Dipartimento di Ingegneria dell'Impresa Via del Politecnico, 1, 00133 Roma RM http://dii.uniroma2.it/
DESCRIPTION	Data streams are characterized by strong aspects of physical, structural, morphological and cultural heterogeneity such that their corresponding reuse is very complex with a limited digital interoperability. In particular, the natural sciences deal with data described at different levels of abstraction, scale, perception and quality. Gaps between data derived from images or time series, for example, can be a major obstacle to their cooperative reuse for the study of predictive models of the underlying natural facts. In AI, Representation Learning algorithms, capable of discovering useful representations in data (geometric embeddings) for very different phenomena, have been proposed in a straightforward manner and without human supervision. This project aims to explore the applicability of state-of-the-art methods (the transformers) to heterogeneous natural data that are multidimensionally related to specific complex natural phenomena.

SCHOLARSHIP N.	**10**
FOUNDED BY	Ex DM 118/2023 - Action Line: Public Administration
TOPIC	Applications of integrated photonics for a new generation of astrophysical space measurements
CURRICULUM	Rivelatori, laser e ottica
CONTACTS	Francesco Bertazzi francesco.bertazzi@polito.it
HOSTING UNIVERSITY/RESEARCH CENTRE	Politecnico di Torino
DEPARTMENT	Dipartimento di Elettronica e Telecomunicazioni - DET Corso Castelfidardo, 39, 10129 Torino TO www.det.polito.it
DESCRIPTION	The proposed research concerns the exciting domain of integrated photonics and its application in the development of novel astrophysical space measurements. Integrated photonics, and in particular silicon photonics, offers immense potential for revolutionizing space observations and measurements. By integrating various photonic components (waveguides, modulators, detectors, filters, etc.) onto a single chip, the size, weight, and power consumption of the observation instruments can be significantly reduced, making them more efficient and cost-effective for space missions. The project involves theoretical investigations, numerical simulations, and experimental characterizations to design and optimize integrated photonic devices tailored for applications such as high-resolution spectroscopy, wide-field imaging, polarimetry, frequency metrology.

SCHOLARSHIP N.	**11**
FOUNDED BY	Ex DM 117/2023
TOPIC	Mechatronics for fundamental physics experiments
CURRICULUM	Meccanica
CONTACTS	Antonio Carcaterra antonio.carcaterra@uniorma1.it
HOSTING UNIVERSITY/RESEARCH CENTRE	Sapienza Università di Roma
DEPARTMENT	Dipartimento di Ingegneria Meccanica e Aerospaziale Via Eudossiana, 19, 00814, Roma https://www.dima.uniroma1.it/dima/
DESCRIPTION	The research activity concerns the use of mechatronic technologies to support experimental systems for fundamental physics. In particular, the investigation of advanced sensor, actuator and controller systems for the monitoring and control of complex mechanical systems is of interest. The fundamental objective is to carry out measurements in extreme conditions for the sensitivity of detection systems, preventing disturbing effects even of very low power. Among the systems of greatest interest are oscillating devices made up of rigid and deformable bodies that interact with electrodynamic systems and both acoustic and optical beams, at room temperature as well as in cryogenic conditions.

SCHOLARSHIP N.	**12**
FOUNDED BY	UNIVERSITY/OTHER BODIES
TOPIC	Definition, development and testing of front-end electronics for high-energy astrophysics detectors
CURRICULUM	Elettronica
CONTACTS	Riccardo Campana riccardo.campana@inaf.it
HOSTING UNIVERSITY/RESEARCH CENTRE	INAF - Osservatorio di Astrofisica e Scienze dello Spazio - OAS di Bologna
DEPARTMENT	Osservatorio di Astrofisica e Scienze dello Spazio - OAS Via Gobetti 101, 40129 Bologna www.oas.inaf.it
DESCRIPTION	The candidate will be inserted in the activity of the ReDSoX collaboration (INAF, INFN, FBK, ASI, PoliMi, UniPV), whose innovative solid state X and gamma-ray sensors and related ASICs for signal readout have led to instruments onboard approved space missions (HERMES, eXTP) and new proposed ones (THESEUS). The candidate will collaborate in testing and characterising the several ASIC prototypes currently available and in defining test procedures according to ECSS standard for acceptance in a space instrument, including performance and radiation tolerance, designing and carrying out dedicated irradiation campaigns at European facilities. The laboratory testing activity will furthermore drive the development of new, improved ASIC designs, in a large and multidisciplinary collaboration, focusing also on the architecture of the electronics and the interface with the instrument/sensor Data Handling system and other requirements, such as power supply constraints and EM shielding.

SCHOLARSHIP N.	**13**
FOUNDED BY	UNIVERSITY/OTHER BODIES
TOPIC	Development and porting of artificial intelligence algorithms on FPGA for nanosecond inference in real-time systems of high energy physics experiments
CURRICULUM	Sistemi di calcolo e informatica
CONTACTS	Stefano Giagu stefano.giagu@roma1.infn.it
HOSTING UNIVERSITY/RESEARCH CENTRE	INFN – Sezione di Roma 1
DEPARTMENT	Piazzale Aldo Moro, 2 - 00185 Roma RM, Italia www.roma1.infn.it
DESCRIPTION	Design of very low latency (inference <500ns/event) and intermediate latency (inference < 1ms/event) Deep Neural Network algorithms with neural networks implemented both on traditional processors equipped with ML extensions and on commercial accelerators (NVIDIA GPU, Xilinx Alveo, ACAP, Edge/DPU (ZCU102/103/104), Intel/Altera systems), for real-time applications in the field of high-energy physics and in technological/industrial applications.

SCHOLARSHIP N.	**14**
FOUNDED BY	UNIVERSITY/OTHER BODIES
TOPIC	Machine Learning techniques for Big Data analysis in space-borne astroparticle physics experiments
CURRICULUM	Sistemi di calcolo e informatica
CONTACTS	Valerio Formato valerio.formato@roma2.infn.it
HOSTING UNIVERSITY/RESEARCH CENTRE	INFN – sezione di Roma Tor Vergata
DEPARTMENT	INFN Sezione di Roma Tor Vergata Via della Ricerca Scientifica, 00133 Roma RM https://www.roma2.infn.it/
DESCRIPTION	Development and optimization of Machine Learning tools and techniques for data analysis in space-borne astroparticle physics experiments. With particular emphasis on background rejection in rare complex-antimatter events search, lepton/hadron separation and computer vision techniques for event reconstruction.

SCHOLARSHIP N.	**15**
FOUNDED BY	UNIVERSITY/OTHER BODIES
TOPIC	Development of innovative robotic systems for remote inspections and interventions in experimental areas
CURRICULUM	Elettrotecnica ed elettrotecnica per acceleratori
CONTACTS	Alberto Andrighetto alberto.andrighetto@lnl.infn.it
HOSTING UNIVERSITY/RESEARCH CENTRE	INFN - Laboratori Nazionali di Legnaro
DEPARTMENT	INFN - Laboratori Nazionali di Legnaro Viale dell'Università, 2 – 35020- Legnaro (PD) – Italia https://www.lnl.infn.it/
DESCRIPTION	Design, build and test automation systems used for inspection, handling and robotics applications in experimental areas by applying innovative methodologies related to mechanical and electronic design, collaboration with other systems and software development.

SCHOLARSHIP N.	**16**
FOUNDED BY	UNIVERSITY/OTHER BODIES
TOPIC	Design of read-out electronics in 28 nm CMOS technology for next generation pixel detectors
CURRICULUM	Elettronica
CONTACTS	Flavio Loddo flavio.loddo@ba.infn.it
HOSTING UNIVERSITY/RESEARCH CENTRE	INFN – Sezione di Bari
DEPARTMENT	INFN Sezione di Bari Via Orabona 4, Bari www.ba.infn.it
DESCRIPTION	The proposed activity consists in the design of integrated circuits in 28nm CMOS technology for reading pixel detectors of the next generation inner trackers for high energy physics experiments. The study and design of circuit architectures to obtain temporal resolutions lower than 50 ps on large arrays of pixels will be addressed, guaranteeing at the same time radiation tolerance of at least 1 Grad and minimizing the power consumption. The final goal is the production of a 64x64 pixel prototype to be characterized both in the laboratory and on the test beam.

SCHOLARSHIP N.	**17**
FOUNDED BY	UNIVERSITY/OTHER BODIES
TOPIC	Hadron Calorimeter MPGD-based development for future Muon Collider experiment
CURRICULUM	Rivelatori, laser e ottica
CONTACTS	Salvatore My salvatore.my@uniba.it
HOSTING UNIVERSITY/RESEARCH CENTRE	Università degli Studi di Bari Aldo Moro
DEPARTMENT	Dipartimento Interuniversitario di Fisica Campus Universitario, Via E. Orabona 4, 70125 Bari, https://www.uniba.it/it/ricerca/dipartimenti/fisica
DESCRIPTION	In the European Strategy for Particle Physics, a multi-TeV Muon Collider has been proposed to investigate the Standard Model with unprecedented precision after the HL-LHC. The design of an experimental apparatus for a Muon Collider is one of the most exciting challenges for the coming years. A crucial role is played by the hadron calorimeter (HCAL), as the main detector involved in the jet reconstruction. The proposed activity foresees the study of an HCAL based on MPGD (Micro Pattern Gas Detector) and will be based on: • Simulation studies with Geant 4 to evaluate the performance of the new MPGD-based HCAL while optimizing the layout. • Simulation studies with the full future experimental apparatus, to evaluate HCAL performance in realistic data taking conditions and derive the geometry and readout parameters. • Development of HCAL cell prototype and performance measurement in lab and test beam.

SCHOLARSHIP N.	**18**
FOUNDED BY	UNIVERSITY/OTHER BODIES
TOPIC	Innovative holographic optical elements for modern optical instrumentation
CURRICULUM	Rivelatori, laser e ottica
CONTACTS	Andrea Bianco andrea.bianco@inaf.it
HOSTING UNIVERSITY/RESEARCH CENTRE	INAF - Osservatorio Astronomico di Brera
DEPARTMENT	INAF Osservatorio Astronomico di Brera Via Brera, 28, 20121 Milano MI http://www.brera.inaf.it/
DESCRIPTION	Holographic optical elements are versatile and they can perform tailored optical functions that improve and/or simplify optical instrumentation. In particular, volume phase holograms show a very high diffraction efficiency and they are good candidate as dispersing elements (VPHGs) in the field of astronomical instrumentation. In this field, INAF has a primary role at the European level. The capability of the holographic elements to modify the optical wavefront can be efficiently exploited in adaptive optics, in the photometry of exoplanets and in the realization of spectrographs with extremely high optical quality. This PhD thesis deals with the development of such holographic optical elements for the different applications starting from the scientific requirements, going through the design and manufacturing and ending up with laboratory and/or on sky tests.

SCHOLARSHIP N.	**19**
FOUNDED BY	UNIVERSITY/OTHER BODIES
TOPIC	Technologies for the phasing of segmented pupil optical telescopes
CURRICULUM	Rivelatori, laser e ottica
CONTACTS	Lorenzo Busoni lorenzo.busoni@inaf.it
HOSTING UNIVERSITY/RESEARCH CENTRE	INAF Osservatorio Astrofisico di Arcetri
DEPARTMENT	INAF Osservatorio Astrofisico di Arcetri Largo Fermi 5 50125 Firenze https://www.arcetri.inaf.it/
DESCRIPTION	Next generation extremely large telescopes feature highly fragmented pupils, divided into optically disconnected areas (segments). Such pupils are due to the segmentation of the primary mirror and to the extended obstruction created by the mechanical structure supporting the secondary mirror. Traditional wavefront sensors and control schemes cannot fully manage the phase discontinuities that are created across the pupil segments, leading to a significant loss of image quality. The thesis work will focus on the development of optical and control technologies for compensating the phase discontinuities in segmented pupil systems, with a particula application to italian-lead instruments MORFEO and ANDES for the Extremely Large Telescope. The work involves designing and building a prototype of the system that can be tested in the laboratory, utilizing the phasing testbed currently under development within the PNRR STILES project.

SCHOLARSHIP N.	**20**
FOUNDED BY	UNIVERSITY/OTHER BODIES
TOPIC	Image recognition development on FPGA through AI in harsh enviroment.
CURRICULUM	Elettronica
CONTACTS	Andrea Fabbri andrea.fabbri@roma3.infn.it
HOSTING UNIVERSITY/RESEARCH CENTRE	Università Roma Tre
DEPARTMENT	Dipartimento di Ingegneria Industriale, Elettronica e Meccanica, Via Vito Volterra 62, 00146 Roma. diiem.uniroma3.it
DESCRIPTION	The project aims to implement image recognition algorithms based on artificial intelligence on latest generation FPGA devices. These algorithm are dedicated to radioactive environments such as space and HEP experimental chambers by identifying the types of errors due to radioactivity (TID, SEU) and developing methodologies to mitigate such errors.

SCHOLARSHIP N.	**21**
FOUNDED BY	UNIVERSITY/OTHER BODIES
TOPIC	Performance study of TimePIX ASICs for 3D track imaging for X-ray Polarimetry in Astrophysics
CURRICULUM	Elettronica
CONTACTS	Paolo Soffitta paolo.soffitta@inaf.it
HOSTING UNIVERSITY/RESEARCH CENTRE	INAF-IAPS di Roma
DEPARTMENT	Alte Energie INAF - Tor Vergata, Via Del Fosso del Cavaliere, 100 - 00133 Roma www.iaps.inaf.it
DESCRIPTION	With the launch of IXPE, X-ray polarimetry has reached full maturity as an investigative tool for X-ray emitting sources. However, the limitations of its ASICs are evident. This thesis will study and optimize the ASICs of the TimePIX family, which promise to achieve accurate 3D tracking in gas, a feature precluded by the previous generation of ASICs. Furthermore, the onboard parallel reading and processing enable its utilization in the case of high fluxes expected from the new generation of optics for studying black holes and neutron stars. Finally, the possibility of tiling on 3 or 4 sides allows for its use in experiments without optics. Further it will allow for the extension of solar flare polarimeters to high energies and wide-field detectors for Gamma Ray Bursts at low energies. The thesis will benefit from the X-ray facility at INAF-IAPS and will be conducted with the group that designed and built the detectors for IXPE.

SCHOLARSHIP N.	**22**
FOUNDED BY	UNIVERSITY/OTHER BODIES
TOPIC	Study, realization and optimization of cryogenic components for Kelvin (K) and milliKelvin (mK) applications
CURRICULUM	Meccanica
CONTACTS	Paolo Gorla paolo.gorla@lngs.infn.it
HOSTING UNIVERSITY/RESEARCH CENTRE	INFN – Laboratori Nazionali del Gran Sasso
DEPARTMENT	Laboratori Nazionali del Gran Sasso Via G. Acitelli, 22 67100 Assergi L'Aquilawww.lngs.infn.it
DESCRIPTION	In recent years, cryogenic temperature devices become of pivotal importance in many applications, such as fundamental and applied physics, mechanical, electronic, chemical, and energy engineering, and quantum computing. Sensors and detectors, tested inside dilution refrigerators at mK or K temperatures, are extremely sensitive to vibration-induced thermal dissipations. The characterization of such devices is extremely complex due to the presence of a pre-cooling stage based on Pulse Tube cryocoolers, which are an intrinsic source of vibrations. This project aims to develop and test innovative devices to reduce vibration at cryogenic temperatures. Such components need not only to reduce vibrations but also to guarantee the thermalization of the dilution refrigerator parts to preserve the thermal equilibrium of the system.

SCHOLARSHIP N.	**23**
FOUNDED BY	UNIVERSITY/OTHER BODIES
TOPIC	New Optical and RF Over Fiber Technologies for New Generation Radio Telescopes
CURRICULUM	Elettronica
CONTACTS	Federico Perini federico.perini@inaf.it
HOSTING UNIVERSITY/RESEARCH CENTRE	Istituto Nazionale di Astrofisica – Istituto di Radioastronomia
DEPARTMENT	Istituto di Radioastronomia, Via Fiorentina, 3513, 40059 Medicina BO http://www.med.ira.inaf.it/
DESCRIPTION	The future discoveries of cosmology, astrophysics and space science require the development of highly performing radiotelescopes reaching an always increasing sensitivity and resolution. The development of such systems depends on several aspects, including the RF signal transport through optical fiber system toward the back-end processing unit, where signal phase and amplitude variations due to temperature and mechanical stresses must be kept as low as possible within the whole receiving chain. Indeed, this is an important aspect which impacts on the calibration processes, especially in wideband interferometric systems where the back-end unit is placed hundreds of meters far from the antenna. The aim of this Ph.D. project is to investigate and implement innovative solutions for the RF signal transportation starting from the experiences we had with SKA, Medicina VLBI dish, Northern Cross and SRT radiotelescopes.

SCHOLARSHIP N.	**24**
FOUNDED BY	UNIVERSITY/OTHER BODIES
TOPIC	Integrated sensors and read-out electronics technologies development for High Energy Physics experiments
CURRICULUM	Rivelatori, laser e ottica
CONTACTS	Arianna Morozzi arianna.morozzi@pg.infn.it
HOSTING UNIVERSITY/RESEARCH CENTRE	INFN- Sezione di Perugia
DEPARTMENT	INFN Perugia, via Pascoli, Perugia https://www.pg.infn.it/
DESCRIPTION	Within the framework of the Future Circular Collider (FCC) at CERN in Geneva, projects are being developed for a new research infrastructure to host the next generation of high-performance particle colliders. This research project arises in this scenario and its main scientific objectives are of developing methodologies and TCAD simulation models for particle sensors and the effects of radiation-induced damage, as well as studying and analyzing state-of-the-art CMOS technologies for the fabrication of monolithic sensors and related read-out electronics of the latest generation by means of Technology CAD (TCAD) and CAD VLSI development platforms.

SCHOLARSHIP N.	**25**
FOUNDED BY	UNIVERSITY/OTHER BODIES
TOPIC	High spatial and temporal resolution pixelated radiation sensors for next generation experiments in fundamental physics
CURRICULUM	Rivelatori, laser e ottica
CONTACTS	Alessandro Cardini alessandro.cardini@ca.infn.it
HOSTING UNIVERSITY/RESEARCH CENTRE	INFN- Sezione di Cagliari
DEPARTMENT	INFN Sezione di Cagliari S.P. per Sestu – Km 0,700, 09042 – Monserrato (Cagliari) www.ca.infn.it
DESCRIPTION	Future experiments in fundamental physics research require advanced radiation sensors with spatial/temporal resolutions of the order of 1µm/1ps respectively, and the capability to withstand an important radiation damage without performance degradation. Recent works on silicon sensors have demonstrated that 3D-trench silicon pixels are able to detect minimum ionizing particles with at least 10ps accuracy. To fully exploit the sensors' performances a state-of-the-art integrated front-end electronics is required and 28 nm CMOS technologies appears to be a promising way to go to build a low-power, radiation-hard, high-resolution front-end system with on-board data processing. The development of high-resolution sensors and electronics for future trackers in high-luminosity collider experiments or for the accurate monitoring of interferometer operation in the next generation gravitational wave experiments will be the subject of this work.

SCHOLARSHIP N.	**26**
FOUNDED BY	UNIVERSITY/OTHER BODIES
TOPIC	Addressing large-scale data processing challenges with solutions tailored for AI-oriented scientific use-cases
CURRICULUM	Sistemi di calcolo e informatica
CONTACTS	Domenico Elia domenico.elia@ba.infn.it
HOSTING UNIVERSITY/RESEARCH CENTRE	INFN- Sezione di Bari
DEPARTMENT	INFN Sezione di Bari Via Giovanni Amendola, 173, 70126 Bari BA https://www.ba.infn.it/it/
DESCRIPTION	Data access and processing can be quite challenging within AI and more specifically ML/DL model applications needing to deal with large, heterogeneous and geographically distributed data sets. Typical use cases to this respect are provided by large (“Big Data”) latest generation HEP experiments which are nearing the Exabyte scale of treated data. The project will explore the possibility to improve existing solutions within the INFN computing infrastructure based on provisioning of on-demand high-level Cloud-based services. These solutions, specifically designed for ML/DL tasks, allow for interactive or batch compute environments. They include services making use of specialized hardware devices like GPUs and fast storage to enable efficient and speedy processing. As application and test use case, a specific analysis based on datasets from one of the large LHC experiments at CERN will be proposed.

SCHOLARSHIP N.	**27**
FOUNDED BY	UNIVERSITY/OTHER BODIES
TOPIC	Analysis of Astrophysical phenomena using efficient and parallelized models on HPC systems
CURRICULUM	Sistemi di calcolo e informatica
CONTACTS	Eva Sciacca eva.sciacca@inaf.it
HOSTING UNIVERSITY/RESEARCH CENTRE	INAF Osservatorio Astrofisico di Catania
DEPARTMENT	INAF Osservatorio Astrofisico di Catania Via Santa Sofia 78, 95123 Catania, Italia https://www.oact.inaf.it/
DESCRIPTION	The research project aims to design and develop efficient and parallelized models, involving advanced visualization techniques and algorithmic solutions for big data analysis, exploiting modern HPC computing systems also in an exascale perspective, for the discovery of astrophysical patterns (such as for example star formation regions or extended sources such as the remains of supernovae) within astronomical maps by combining information from different wavelengths (from infrared to radio) and from cosmological simulations. The project proposes innovative solutions related to the processing of large images and to identify the models for the acceleration of the computation through the realization of portable algorithms with multi-platform paradigms and optimization of the pipeline of image reduction on platforms with GPU through the exploitation of libraries for Artificial Intelligence.

SCHOLARSHIP N.	**28**
FOUNDED BY	UNIVERSITY/OTHER BODIES
TOPIC	Advanced computing systems for Gravitational-wave research
CURRICULUM	Sistemi di calcolo e informatica
CONTACTS	Stefano Bagnasco bagnasco@to.infn.it
HOSTING UNIVERSITY/RESEARCH CENTRE	INFN – Sezione di Torino
DEPARTMENT	INFN Sezione di Torino via Pietro Giuria, 1 10125 Torino www.to.infn.it
DESCRIPTION	The next generation of ground-based gravitational waves observatories will face, in a decade from now, a very large growth in the rate of detected events, thus posing novel challenges in the low-latency data analysis needed to provide alerts for multimessenger astronomy. The growing adoption of AI/ML technologies, not yet routinely used in low-latency data processing, will require both R&D in the application of ML techniques to GW signal extraction and de-noising and the development of an e-Infrastructure for model training and re-training, archival and distribution of trained models, and inference, alongside with more conventional data distribution and processing.

SCHOLARSHIP N.	**29**
FOUNDED BY	Ex DM 118/2023 - Action Line: PNRR
TOPIC	CAP - CMOS Advanced Pixels
CURRICULUM	Elettronica
CONTACTS	Pietro Giubilato piero.giubilato@unipd.it
HOSTING UNIVERSITY/RESEARCH CENTRE	Università degli Studi di Padova
DEPARTMENT	INFN Sezione di Padova Via Francesco Marzolo, 8, 35121 Padova PD
DESCRIPTION	The CAP R&D project aims developing innovative microelectronic design solution for the realization of novel CMOS Monolithic Active Pixel Sensors (MAPS) in the 65 nm or deeper technology node, exploiting the stitching technique in order to realize single-die, ultra-large sensors. Main goals is investigating solutions on how to limit the power drop along the power lines, creating an efficient in-chip data distribution infrastructure, and ensuring adequate reliability. On the radiation side, the deice will have to withstand at least 5×10^15 1 MeV neq cm^-2 at above-zero temperatures. Time resolution will target the 100 ns mark, while the pixel pitch will have to be about 10 um, and the power consumption limited to about 30 mW cm^-2. A relevant characteristics of the CAP project is the outreach outside the HEP world: a device with the planned characteristics, will greatly impact many applications, like spaceborne telescopes, light science apparatuses, medical imaging, etc.

SCHOLARSHIP N.	**30**
FOUNDED BY	UNIVERSITY/OTHER BODIES – FREE RESEARCH TOPIC
TOPIC	
CURRICULUM	
CONTACTS	Giuliana Fiorillo Alberto Aloisio giuliana.fiorillo@unina.it / giuliana.fiorillo@na.infn.it alberto.aloisio@unina.it / aaloisio@na.infn.it
HOSTING UNIVERSITY/RESEARCH CENTRE	INFN - Sezione di Napoli
DEPARTMENT	INFN - Sezione di Napoli Complesso universitario di Monte Sant'Angelo, Via Cinthia, 80126 Napoli https://www.na.infn.it/
DESCRIPTION	